

Comparative study of some nutritionally important components on different cabbage (*Brassica oleracea* L.) genotypes

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Summary: Vegetables of *Brassicaceae* are especially important because of their inner values, which play a provably positive role in curing and preventing diseases. Cabbage (*Brassica oleracea* L. convar. *capitata* prov. *capitata*) is still today one of the most frequently consumed green vegetables, which is known to brake the absorption of carcinogenous substances and to obstruct cell mutation. Different cabbage cultivars were compared growing under the same circumstance. The level of different carbohydrate fractions and some biologically active quaternary ammonium compounds were determined. In all cases we analyzed the antioxidant capacity of samples characterizing the free radical scavenging capacity.

Clearly detectable significant differences were found between the varieties tested, which appeared suitable for selecting the most precious varieties for human nutrition.

Key words: *Brassica*, carbohydrates, quaternary ammonium compounds, antioxidant capacity

Introduction

The latest investigations proved, that besides genetical disposition, lifestyle and nutrition also play a decisive role in human health care and inhibit the occurrence of many diseases.

Reactive oxygen species – free radicals – are produced during normal aerobic metabolism. These free oxygen species are highly reactive, and may cause tissue damage by reacting with biomolecules, such as DNA, polyunsaturated fatty acids, proteins.

Free radical damage has been associated with almost every chronic degenerative disease, including cancer, cardiovascular disease. These radicals are removed by a defence system of antioxidants. Antioxidant enzymes and low molecular weight antioxidant molecules prevent the generation of reactive oxygen species, or destroy them.

It is a proven fact, that antioxidants have an important role in preventing cell damage – cancer, senescence and many other alterations leading to diseases. Supplementing the first pieces of experience and observations with scientific investigations, it turned out that food contains several components which may strengthen the common physiological functions, enhance the natural protecting systems of the body and the elimination of reactive radicals. That is why vegetables and fruits play important role in food chain.

Comparing varieties on the basis of compounds with different positive effects may help in determining goals of

breeding and selecting varieties of promising biological values.

Vegetables of *Brassica* genus belong the most frequently consumed vegetables. Their growing area is 6–7% of the total vegetable growing area. All-round use of cabbage in provisioning and people's traditional therapy is known for a long time. Nowadays it is one of the most frequently consumed green vegetables, which is known to restrict the absorption of carcinogenous substances and to inhibit cell mutation.

According to the lately published research results, the vegetables of *Brassica* genus are the finest nutriment against cancer (Bonnesen et al., 2001).

In nutritional respect, the level of carbohydrates and the partial quantity of the different fractions fundamentally determine the pleasure value. From the great range of their important role in consumption, their effect in storage can be emphasized. The composition of carbohydrates changes after harvest and during storage. Genetic and environmental factors may affect the qualitative and quantitative composition of sugar fractions by influencing the activity of those enzymes, which are involved in synthesis and oxidation processes (Xiangyang & Lianqing, 2000).

Latest investigations highlight the important role of choline among quaternary ammonium compounds, because on one hand it takes part in the process of hindering the accumulation of cholesterol, helping metabolism, consuming fatty acids, detoxicating the body and on the other hand

during brain metabolism it is transformed into acetyl-choline that is the stimulus carrier substance of the nervous system. Carnitin plays a role in the process of fatty acids passing through the mitochondrium membrane which is very important for the human health.

The efficiency of the elimination of free radicals that are hazardous substances for the living organisms are characterized by a total antioxidant capacity. Numerous publications prove the outstanding antioxidant effects of the *Brassicaceae* species (Ninfali et al., 2003; Llorach et al., 2003; Kurilich, 2002). It is well known that fruits and vegetables are rich sources of antioxidants because of their carotenoids, flavonoids and plant phenolic compounds.

According to our objectives those compounds and groups of compounds were investigated which presumably or provenly play a role in plant disease resistance or due to the healthy effect of consuming fruits and vegetables, in the human health condition. These results can help on the one hand in breeding more resistant varieties (hybrids) which are rich in natural immun-stimulating factors, starting their cultivation, putting them into market circulation; and on the other hand producing varieties with especially high active ingredient content, which affects life conditions positively.

Material and method

Separation and determination of carbohydrates

The leaves were frozen with liquid nitrogen, powdered and extracted with methanol: H₂O = 80:20, V/V. This suspension was centrifuged at 1500 g for 10 minutes at -1 °C. The clear supernatants were used for overpressured layer chromatographic separations (OPLC 50 chromatograph developed by OPLC-NIT Ltd., Budapest, Hungary; Mincsovcics et al., 1999, 2003). OPLC separations were carried out on TLC and HPTLC silica gel 60 F₂₅₄ precoated chromatoplates (Merck Co., Darmstadt, Germany)

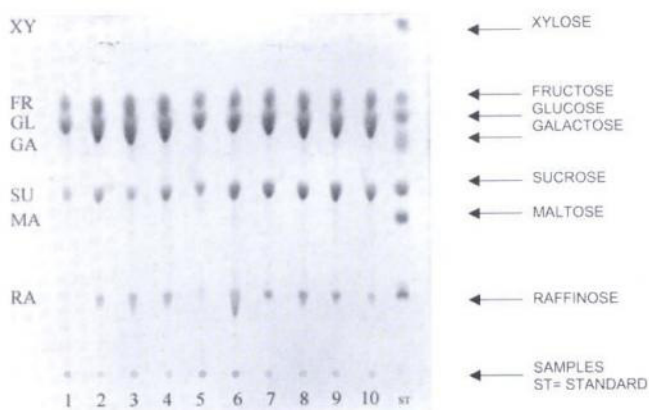


Figure 1 Example for the separation of the carbohydrates

using acetonitrile: H₂O (85:15, V/V). Staining was performed by aniline- diphenyl amine – phosphoric acid reagent. For densitometric determination (Figure 1) a Shimadzu CS-930 TLC/HPTLC scanner (Shimadzu Co., Kyoto, Japan), $\lambda = 540$ nm was used (Sárdi et al., 1996).

Separation and determination of fully N-methylated compounds

The leaves were frozen with liquid nitrogen, powdered and suspended in dimedone solution (0.05% dimedone in methanol) (e.g. 0.30 g plant powder/ 0.7 ml of 0.05% dimedone solution). This suspension was centrifuged at 1500 g for 10 minutes at 4°C. The clear supernatants were used to OPLC separations.

The separations were carried out on OPLC silica gel 80 F₂₅₄ precoated chromatoplates using a chloroform – methylenechloride mixture (35:65,V/V) for formaldemethone determination and an i-propanol – methanol – 0.1M sodium acetate mixture (20:3:30,V/V) for quaternary ammonium compounds. Calibration curves were made by means of authentic substances (at $\lambda = 265$ nm for formaldemethone and at $\lambda = 525$ nm for quaternary ammonium compounds which were detected by Dragendorff reagent) (Gersbeck, et al., 1989). Densitograms were taken with a Shimadzu CS-930 scanner. Samples were applied with a NANOMAT sample applicator.

Antioxidant capacity

Antioxidant power (mM ascorbic acid/L) was measured by the FRAP (Ferric Reducing Ability of Plasma) method at $\lambda = 593$ nm using tri-pyridyl-triazine (Benzie et al., 1996).

Results

Our results indicate that there are significant differences in the carbohydrate components between cabbage varieties. We have detected the highest concentration of glucose and fructose (Figure 2).

Between the lowest and the highest values of glucose and fructose content we demonstrated about twice differences.

We measured fourfold differences between the sucrose quantity of samples, while values of raffinose reflected nearly fivefold differences.

During comparison of the quantity of quaternary ammonium compounds we have found detectable differences in the choline concentration (Figure 3).

Values of the choline reflected a nearly threefold difference between the samples possessing the highest and the lowest choline content.

One of the tested cabbage varieties (1 sample) showed a prominently high choline content.

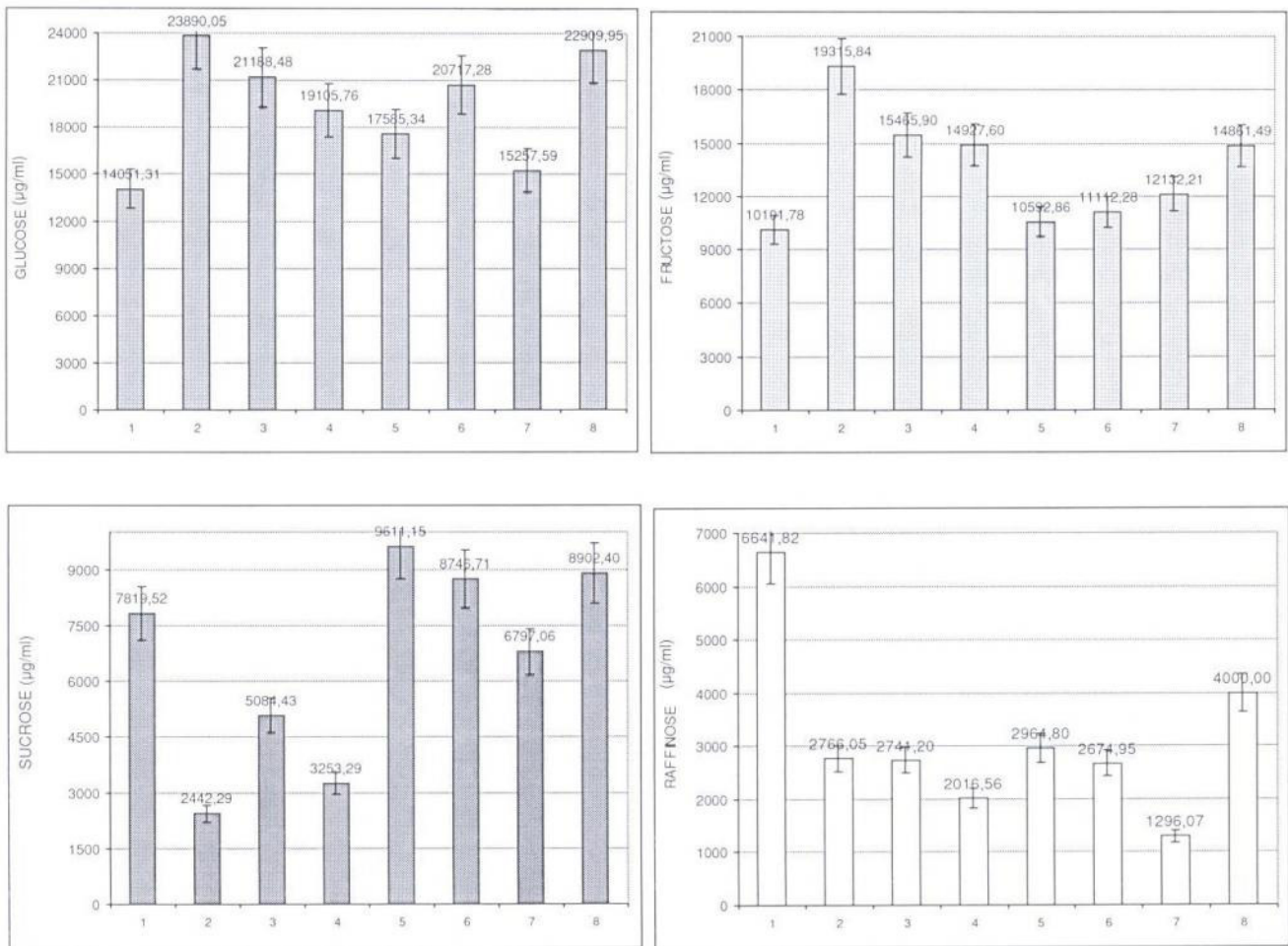


Figure 2 The concentration of different carbohydrates

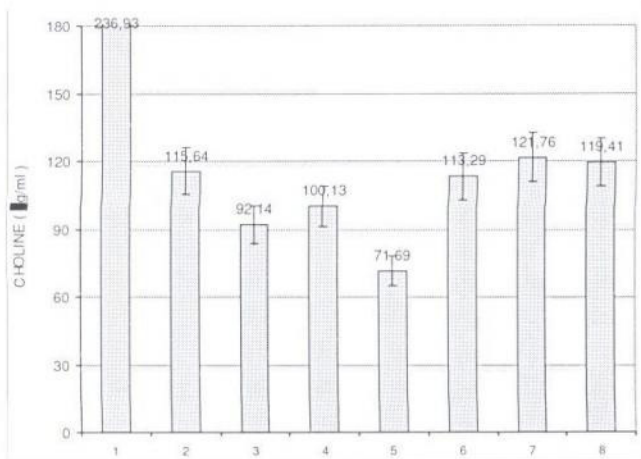


Figure 3 Choline concentration of different cabbage varieties

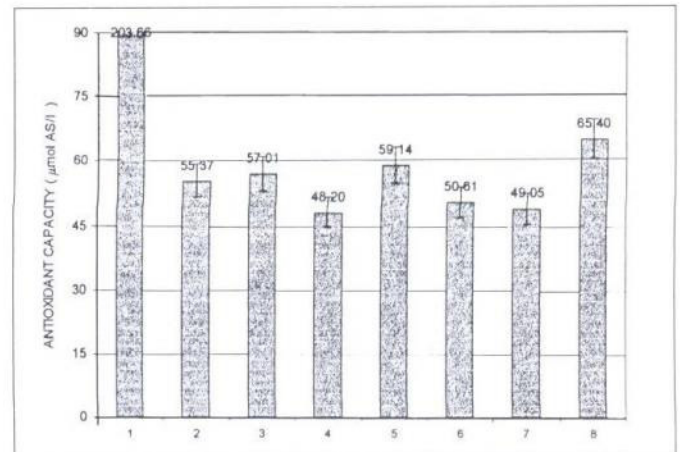


Figure 4 Antioxidant capacity of different cabbage varieties

In cabbage-heads N^c-trimethyl-L-lizine (TML) and carnitin were also found, but under the given measuring conditions their quantities were hardly detectable.

In all cases antioxidant capacity was determined, results are shown in Figure 4. We have found a high antioxidant capacity in the sample1, it was similar in case of choline.

Conclusions

Green vegetables of *Brassica* genus are specially important because of their inner values playing a positive role in fighting against diseases. We investigated those biochemical parameters of the plants, which carry provenly

valuable characteristics for human nutrition and take part in plant resistance, in biotic and abiotic stress reactions, in senescence processes, and in changes which occur during storage.

One of our objectives were to compare varieties in respect of endogenous carbohydrates, quaternary ammonium compounds, and the antioxidant capacity. According to the examination of carbohydrates there were clearly detectable differences among varieties originated from the same site, in case of all carbohydrate fractions.

Among quaternary ammonium compounds choline – which is correlated with plant disease resistance – concentration was high, but the quantity of N^c-trimethyl-L-lizine (TML) and carnitin was low in cabbage varieties.

On the basis of our results we could assess the closest correlation between the antioxidant power and the choline content of the samples.

Our results may assist in selecting of promising, biologically valuable cabbage varieties; keeping them into cultivation; putting them on the market; determining breeding objectives and establishing new varieties carrying valuable characteristics for human nutrition.

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